CLAIMS

What is claimed is:

1. A controller system for distributing line voltage from a line voltage service to one or more line voltage loads and controlling operation of a service system for a bathing installation such as a spa, comprising:

a housing structure;

a controller printed circuit board mounted within the housing, including a plurality of line voltage output terminals for connection to respective line voltage loads via line voltage wiring connections, a set of circuit board line voltage contact surfaces, a plurality of circuit conductors for providing circuit connections between the contact surfaces and respective ones of the line voltage output surfaces, wherein the controller circuit board routes line voltage from the circuit board line voltage contact surfaces to the output terminals;

a line voltage connector structure non-removably mounted on the circuit board, said connector structure having a set of line voltage connectors, each line voltage connector including a connector for connection of a corresponding set of line voltage service conductors and a connector line voltage conductor pin soldered to one of said circuit board line voltage contact surfaces;

a plurality of line voltage load connectors non-removably mounted on the circuit board, each of said line voltage load connectors including a set of terminals for connection to line voltage load wiring and a set of pins soldered to respective ones of the line voltage output surfaces.

2. The system of Claim 1 further including:

a plurality of sets of line voltage conductors for connections from the line voltage load connectors to the respective plurality of line voltage loads; and

a strain relief clamp structure integrated with the housing structure for clamping the plurality of sets of line voltage conductors in place.

3. The system of Claim 1 further comprising a voltage transformer for transforming the line voltage to low voltage levels mounted on the circuit board, and wherein the printed circuit board includes:

a plurality of low voltage conductors running from the voltage transformer to a plurality of low voltage pads;

at least one low voltage connector structure mounted on the printed circuit board for removable connection to low voltage wiring running to low voltage devices.

4. The system of Claim 1 wherein the printed circuit board has mounted thereon a plurality of non-resettable circuit protection devices for providing circuit protection for the line voltage loads.

5. The system of Claim 4, wherein the circuit protection devices include fuse devices mounted on the printed wiring board.

6. The controller system of Claim 1, wherein the circuit board assembly includes a prefabricated printed wiring board including conductor traces, and the plurality of circuit conductors are defined by a set of said circuit traces.

7. The controller system of Claim 1, wherein said line voltage supply is a line voltage supply having a neutral conductor, a first phase conductor and a second phase conductor, and the first phase conductor and the second phase conductor are connected by a corresponding one of said connectors.

8. The controller system of Claim 1, further comprising:

a voltage transformer mounted on the printed circuit board for transforming line voltage to low voltage; and

wherein the controller circuit board has mounted thereon a plurality of low voltage switches for selectively applying low voltage to respective low voltage output wiring connections.

9. The system of Claim 8, further comprising a microprocessor or microcomputer mounted on the printed circuit board and powered by the low voltage.

10. The system of Claim 1, further comprising:

a ground connection terminal block structure mounted to a wall of the housing, including a connector for connecting to an earth ground wire.

11. The system of Claim 10, wherein:

the housing structure is fabricated from an electrically conductive material;

the printed circuit board includes one or more conductive ground pads on a lower surface thereof;

the printed circuit board is mounted to the housing structure by one or more electrically conductive standoff structures which contact the one or more ground pads and a surface of the housing structure, providing electrical continuity between the one or more ground pad and the connector for connecting to an earth ground wire.

12. The system of Claim 11, wherein the housing structure includes a first opening through which the earth ground wire is passed from outside the housing structure to inside the housing structure, and a second opening through which the earth ground wire is passed to connect to the connector.

13. The system of Claim 1, further comprising:

a plurality of electrically actuated switching devices mounted to the printed circuit board for switching line voltage to the line voltage load contact surfaces, the switching devices controlled by a microprocessor or microcomputer mounted on the circuit board.

14. The system of Claim 1, further comprising a jumper wiring arrangement allowing one or more of the line voltage load connectors to be connected to 120V or 240V.

15. The system of Claim 1, wherein said housing structure includes a wall, said system further including a strain relief clamp structure integrated with the housing structure for clamping wiring conductors passed through the housing structure and connected to said controller printed circuit board, said strain relief clamping structure comprising:

a wall clamping surface defined in said wall;

a clamp member adapted to be secured to said wall in a clamping position, wherein the wiring conductors are clamped between said clamp member and said wall clamping surface.

16. The system of Claim 15, wherein said wall clamping surface is defined along a top edge of said wall.

17. The system of Claim 16, wherein said clamp member is mounted for hinged movement between an open position and said clamping position.

18. The system of Claim 16, wherein said wall clamping surface comprises a series of channels formed in said top edge to receive wiring conductors, and said clamp member has a series of relieved areas formed along a longitudinal clamp member edge in correspondence with said series of channels.

19. The system of Claim 18, wherein each of said series of channels formed in said top edge are sized for a given wiring conductor diameter.

20. The system of Claim 18, wherein said series of channels are of a plurality of widths to accommodate wiring conductors of different diameters.

21. The system of Claim 1, said controller printed circuit board includes an isolated circuit board line voltage contact surface, and first and second wire connectors, said first wire connector electrically connected to a first one of said line voltage service conductors, said second wire connector electrically connected to a second one of said line voltage conductors, said system further comprising a jumper wire connectable between said first wire connector or said second wire connector.

22. An integrated water heater and controller system for distributing line voltage from a line voltage service to one or more line voltage loads and controlling operation of a service system for a spa, comprising:

a housing structure;

a water heater having a water inlet and a water outlet, said heater attached to said housing structure;

a controller printed circuit board mounted within the housing, including a plurality of line voltage output terminals for connection to respective line voltage loads including said water heater, a set of circuit board line voltage contact surfaces, a plurality of circuit conductors for providing circuit connections

between the contact surfaces and respective ones of the line voltage output surfaces, wherein the controller circuit board routes line voltage from the circuit board line voltage contact surfaces to the output terminals;

a line voltage connector structure non-removably mounted on the circuit board, said connector structure having a set of line voltage connectors, each line voltage connector including a connector for connection of a corresponding set of line voltage service conductors and a connector line voltage conductor pin soldered to a board line voltage contact surface;

a plurality of line voltage load connectors non-removably mounted on the circuit board, each load connector including a set of terminals for connection to line voltage load wiring and a set of pins soldered to respective ones of the line voltage output surfaces; and

a microprocessor or microcomputer mounted on the circuit board for controlling operation of the service system including said water heater, said line voltage loads and at least one low voltage device.

23. The system of Claim 22 further including:

a plurality of sets of line voltage conductors for connections from the line voltage load connectors to the respective plurality of line voltage loads; and

a strain relief clamp structure integrated with the housing structure for clamping the plurality of sets of line voltage conductors in place.

24. The system of Claim 22 further comprising a voltage transformer for transforming the line voltage to low voltage levels mounted on the circuit board, and wherein the printed circuit board includes:

a plurality of low voltage conductors running from the voltage transformer to a plurality of low voltage pads;

at least one low voltage connector structure mounted on the printed circuit board for removable connection to low voltage wiring running to said at least one low voltage device.

25. The system of Claim 22 wherein the printed circuit board has mounted thereon a plurality of non-resettable circuit protection devices for providing circuit protection for the line voltage loads.

26. The system of Claim 25, wherein the circuit protection devices include fuse devices mounted on the printed wiring board.

27. The system of Claim 22, wherein the circuit board assembly includes a prefabricated printed wiring board including conductor traces, and the plurality of circuit conductors are defined by a set of said circuit traces.

28. The system of Claim 22, wherein said line voltage supply is a line voltage supply having a neutral conductor, a first phase conductor and a second phase conductor, and the first phase conductor and the second phase conductor are connected by a corresponding one of said connectors.

29. The controller system of Claim 22, further comprising:

a voltage transformer mounted on the printed circuit board for transforming line voltage to low voltage; and

wherein the controller circuit board has mounted thereon a plurality of low voltage switches for selectively applying low voltage to respective low voltage output wiring connections.

30. The system of Claim 29, wherein said microprocessor or microcomputer is powered by the low voltage.

31. The system of Claim 22, further comprising:

a ground connection terminal block structure mounted to a wall of the housing, including a connector for connecting to an earth ground wire.

32. The system of Claim 31, wherein:

the housing structure is fabricated from an electrically conductive material;

the printed circuit board includes one or more conductive ground pads on a lower surface thereof;

the printed circuit board is mounted to the housing structure by one or more electrically conductive standoff structures which contact the one or more ground pads and a surface of the housing structure, providing electrical continuity between the one or more ground pad and the connector for connecting to an earth ground wire.

33. The system of Claim 32, wherein the housing structure includes a first opening through which the earth ground wire is passed from outside the housing structure to inside the housing structure, and a second opening through which the earth ground wire is passed to connect to the connector.

34. The system of Claim 22, further comprising:

a plurality of electrically actuated switching devices mounted to the printed circuit board for switching line voltage to the line voltage load contact surfaces, the switching devices controlled by said microprocessor or microcomputer.

35. The system of Claim 22, further comprising a jumper wiring arrangement allowing one or more of the line voltage load connectors to be connected to 120V or 240V.

36. The system of Claim 22, wherein said housing structure includes a wall, said system further including a strain relief clamp structure integrated with the housing structure for clamping wiring conductors passed through the housing structure and connected to said controller printed circuit board, said strain relief clamping structure comprising:

a wall clamping surface defined in said wall;

a clamp member adapted to be secured to said wall in a clamping position, wherein the wiring conductors are clamped between said clamp member and said wall clamping surface.

37. The system of Claim 36, wherein said wall clamping surface is defined along a top edge of said wall.

38. The system of Claim 37, wherein said clamp member is mounted for hinged movement between an open position and said clamping position.

39. The system of Claim 36, wherein said wall clamping surface comprises a series of channels formed in said top edge to receive wiring conductors, and said clamp member has a series of relieved areas formed along a longitudinal clamp member edge in correspondence with said series of channels.

40. The system of Claim 39, wherein each of said series of channels formed in said top edge are sized for a given wiring conductor diameter.

41. The system of Claim 39, wherein said series of channels are of a plurality of widths to accommodate wiring conductors of different diameters.

42. The system of Claim 22, said controller printed circuit board includes an isolated circuit board line voltage contact surface, and first and second wire connectors, said first wire connector electrically connected to a first one of said line voltage service conductors, said second wire connector electrically connected to a second one of said line voltage conductors, said system further comprising a jumper wire connectable between said first wire connector or said second wire connector.